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Solutions

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<b>13. ABSTRACT (Maximum 200 Words)</b> The Washington Academy of Biomedical Engineering (WABME) is an interdisciplinary and multi-institutional effort to promote research, technology transfer, and education in biomedical engineering in the national capital region. The core members of WABME are faculty from the biomedical engineering/bioengineering programs and activities of The Catholic University of America, Georgetown University, The George Washington University and Howard University. A prime component of WABME activities is a quarterly series of research workshops, which bring together problem-rich biomedical disciplines and solution-rich engineering and scientific disciplines. These workshops build connections within the local biomedical engineering community and enable researchers to form new alliances for tackling complex research challenges. Workshop topics have included: "Cancer Imaging for the Operating Room of 2020", "Targeted Hydrogels Induce the Body to Repair Itself", and "Technology for Promotion of Health & Independence Through the Lifespan", and "Geometrical and Physical Models in Medical Image Analysis: Fundamentals and Clinical Applications". MRMC support has enabled both high-quality workshops and technical equipment/training for making a compelling, permanent teaching archive from the workshop content in the form of video and written reports. Furthermore, WABME's framework facilitated several multi-institutional research and education grants, which will significantly enhance biomedical engineering training in the Washington DC area.				
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## TABLE OF CONTENTS

COVER PAGE .....	1
SF 298.....	2
TABLE OF CONTENTS.....	3
INTRODUCTION.....	4
BODY .....	4-9
KEY RESEARCH ACCOMPLISHMENTS.....	10
REPORTABLE OUTCOMES.....	10
CONCLUSIONS.....	10
REFERENCES.....	10
APPENDICES .....	10

## **I. INTRODUCTION**

The Washington Academy of Biomedical Engineering (WABME) is an interdisciplinary and multi-institutional effort to promote research, technology transfer, and education in biomedical engineering in the national capital region. The core members of WABME are faculty from the biomedical engineering/bioengineering programs and activities of The Catholic University of America, Georgetown University, The George Washington University and Howard University. These members meet monthly to discuss innovations in biomedical engineering research, collaborate on cross-cutting grant applications, and learn/share 'best practices' for engineering education. The current leadership of WABME is as follows:

Dr. Murray Loew, The George Washington University, President  
Dr. Seong K. Mun, Georgetown University, Program Director  
Dr. Mohamed Chouikha, Howard University, Membership Director  
Dr. Binh Tran, The Catholic University of America, Finance Director  
Dr. Kenneth H. Wong, Georgetown University, Secretary

A prime component of WABME activities is a quarterly series of research workshops, which bring together problem-rich biomedical disciplines and solution-rich engineering and scientific disciplines. These workshops build connections within the local biomedical engineering community (including academic institutions, federal agencies, non-profit groups, and corporations) and enable researchers to form new alliances for tackling complex research challenges. Workshop topics span a wide range of disciplines including medical imaging, informatics, tissue engineering, telemedicine, and rehabilitation. MRMC has been instrumental in supporting these important scientific events; this report describes the workshops and other WABME activities in greater detail.

## **II. BODY**

The following pages describe the WABME Workshops, including title, date, principal speakers, and executive summary. The list covers all WABME workshops up to the date of the report submission.

## **Individualized Treatment Using Pharmaco-Genomics & Functional Imaging**

Hosted by The George Washington University

Sept. 29, 2003

### **Workshop Speakers**

Michael R. Fannon, M.B.A.

Vice-President and Chief Information Officer, Human Genome Sciences, Inc.

Donald Johann, M.D.

NCI-FDA Proteomics Program, FDA-NCI Clinical Proteomics Program Databank

Steven R. Patierno, Ph.D.

Professor of Pharmacology and Genetics, The George Washington University

Executive Director, The George Washington University Cancer Institute

### **Workshop Summary**

The fields of pharmaco-genomics and functional imaging offer new opportunities for drug development and patient care. Exploration is underway to examine the impact of individual genetic variations in response to drug treatment. This work is expected to improve understanding and treatment of such medical conditions as asthma, cancer, pain, and addictive behavior. Progress in methods of phenotyping and genotyping should aid diagnosis, and guide the drug of choice for an individual, as well as drug dosage and regimen. At the same time, new imaging techniques permit early identification of tumor-cell changes and tumor microcirculation. This information can be expected to lead to better differentiation between "responders" and "non-responders" to chemotherapy for patients with a range of cancer types. This workshop examined the prospects for transitioning these genetic-based pharmacologic and imaging methods from bench to bedside and the impact of these technologies on large-scale clinical trials.

## **Cancer Imaging for the Operating Room of 2020**

Hosted by Georgetown University

November 12, 2003

### **Workshop Speakers**

Gary Dorfman, M.D.

Acting Chief, Image-Guided Diagnosis and Therapy Branch, Cancer Imaging Program, NCI, NIH

Kirby Vosburgh, Ph.D.

Associate Director, Center for Integration of Medicine & Innovative Technology (CIMIT)

Matthew Freedman, M.D., M.B.A.

Associate Professor of Oncology, Lombardi Comprehensive Cancer Center, Georgetown University

John W. Haller, Ph.D.

Acting Director, Division of Applied Science and Technology, NIBIB, NIH

John H. Lynch, M.D.

Professor and Chair, Department of Urology, Georgetown University

### **Workshop Summary**

Dr. Gary Dorfman focused his talk on the use of imaging in oncologic interventions and how it influences clinical trials. Imaging is used throughout the treatment process, from initial diagnosis and staging to treatment to monitoring therapy response. Images represent a wealth of data and should be treated with the same rigor as other clinical data in that there should be strong standards for its collection and evaluation. Images are often viewed as biomarkers of a patient's health (either anatomical or functional), and thus need to be carefully validated. For example, many tumors are (for the sake of simplicity) assessed by measuring their longest dimension on a 2D image as opposed to measurement of the 3D tumor volume. Furthermore, many imaging modalities are not yet optimized for the particular task of image-guided interventions. The combination of functional and anatomical imaging can improve patient care since we will not have to depend solely on anatomic changes to assess tumor response.

Dr. Kirby Vosburgh surveyed many of the current approaches to image-guided interventions, highlighting several exciting research areas. The first is the increased use of the vasculature for interventions, as blood vessels provide a natural highway through the body and can be easily visualized in many modalities, which can be of great benefit when assessing organ deformation. The second is the combination of real-time imaging (such as ultrasound) with preoperative imaging (such as CT). A third key innovation is the use of imaging to follow minimally invasive therapies as they are being delivered, such as cryotherapy for the liver or MRI-guided prostate brachytherapy. Many challenges remain for the field (e.g., what level of intraoperative information is helpful without overwhelming the physician), but all of these technologies can significantly benefit patients.

Dr. Matthew Freedman offered a clinical perspective on several areas where imaging is making an impact on medical care, including measurement of hypoxia/ischemia, localization of tumor boundaries using PET and optical tracers, and advanced surface modeling for reconstructive surgery.

Dr. John Haller presented an overview of the NIBIB and its role in facilitating research into cancer imaging, including a review of current grant programs.

Dr. John Lynch discussed advances in urologic applications, with a special emphasis on his recent research in image-guided prostate therapy.

## **Targeted Hydrogels Induce the Body to Repair Itself**

Hosted by Howard University

February 17, 2004

### **Workshop Speakers**

Peter Moy, Ph.D.

Biomaterials Director, NIBIB, NIH

Jennifer H. Elisseeff, Ph.D.

Assistant Professor of Biomedical Engineering, Johns Hopkins University

Michael B. Lawrence, Ph.D.

Associate Professor of Biomedical Engineering, University of Virginia

### **Workshop Summary**

Dr. Peter Moy of the National Institute of Biomedical Imaging and Bioengineering (NIBIB) provided an overview of biomaterials research from the perspective of the newly formed NIBIB. Although the NIBIB is the newest of the NIH institutes, it already manages a yearly budget of approximately \$280 million (FY 2004). The broad mission of the NIBIB is "To improve health by supporting and conducting focused and multi-disciplinary research and research training in biomedical imaging and bioengineering. This includes supporting the development and translation of emerging technologies that enable fundamental discoveries and facilitate disease detection, management and prevention". NIBIB differs from other institutes because (1) its focus is on the development of imaging and bioengineering technologies that have the potential for broad biomedical applications and because (2) it supports technology- and design-driven research in addition to hypothesis-driven research. Biomaterials projects currently supported by the NIBIB include artificial muscles, erodible drug delivery systems, and nanopatterned biomaterials. Current funding opportunities sponsored by the NIBIB were also reviewed.

Dr. Jennifer H. Elisseeff from Johns Hopkins University presented research results from her work in tissue engineering. She and her colleagues use an implantable system to facilitate cartilage growth in mouse models. A combination of polymers, cells and growth factors are placed subcutaneously in the mouse flank, and then irradiated using ultraviolet light. The light causes crosslinking in the polymers, resulting in a stronger framework in which the cells may grow. This technology will eventually be used to repair injured or defective joints in human patients.

Dr. Michael B. Lawrence from the University of Virginia presented research results from his work in cellular biology, specifically focusing on the adhesion of leukocytes and neutrophils in inflammatory processes. These cells are a vital component of the immune system, and understanding how these cells identify and tether to intravascular targets can teach us how to design customized drug delivery systems. His group has tested a synthetic delivery system that consists of hydrogel microparticles conjugated with HuEP (Humanized E- and P-selectin), and showed that these particles can target endothelium in vivo in a murine model.

## **Technology for Promotion of Health & Independence Through the Lifespan**

Hosted by The Catholic University of America

April 26, 2004

### **Workshop Speakers**

William Herman

Deputy Director, Office of Science & Engineering, Center for Devices and Radiological Health, FDA

Michael J. Rosen, Ph.D.

Director, Rehabilitation Engineering, National Rehabilitation Hospital

Alan Dubow

Vice President, ViTelNet

Albert J. Browne

Vice President, Community Preservation and Development Corporation

### **Workshop Summary**

The rapidly growing elderly population in the United States and abroad presents tremendous challenges to the healthcare enterprise. This symposium brought together national experts in the field of telehealth, telerehabilitation, and telemedicine. Conceptual and practical models relating the role of technology to facilitating health, function, and independent living throughout the lifespan were presented. Specific applications and technology include remote health monitoring, remote rehabilitation service delivery models, environmental activity/monitoring, web-accessible information resources, and home-based health technologies.

# Geometrical and Physical Models in Medical Image Analysis: Fundamentals and Clinical Applications

Hosted by The George Washington University  
February 17, 2004

## Workshop Speakers

James S. Duncan, Ph.D.

Professor of Diagnostic Radiology, Biomedical Engineering, and Electrical Engineering, Yale University

Ronald M. Summers, M.D., Ph.D.

Chief, Clinical Image Processing Service and Virtual Endoscopy and Computer-Aided Diagnosis Laboratory, Department of Radiology, NIH

Michael J. Manyak, M.D.

Professor and Interim Chairman, Department of Urology and Professor of Microbiology and Tropical Medicine, The George Washington University Medical Center

## Workshop Summary

The keynote speaker for this workshop was Dr. Jim Duncan, who offered an excellent overview of how signal and image processing techniques can be applied in many areas of medical imaging. Several large challenges remain for the field:

1. We need to know how to model abnormal structures such as tumors so that we can better recover information from these objects during imaging.
2. It is important to integrate imaging information over multiple length scales, from microscopic imaging to full-body imaging.
3. Incorporating more *a priori* knowledge of the imaging physics will enable us to better understand the result, especially in the arena of ultrasound.
4. Core algorithms and principles should be widely distributed so that we don't need to "reinvent the wheel" in multiple locations/labs.
5. Robust validation and evaluation of imaging technologies using standardized datasets is important for demonstrating which technologies will bring greatest benefit to the patients.

Dr. Ron Summers discussed his work with computer-aided detection and visualization in radiologic applications, focusing on the areas of virtual bronchoscopy and virtual colonoscopy. The task of examining a structure as complex as the colon with a computer observer has many challenges, such as how to specify the shape of a colon polyp so that it is not confused with normal anatomical variations in the colon. Nevertheless, significant advances have been made in this field and virtual colonoscopy has important advantages, such as the ability to find polyps that might otherwise be missed because they are hidden by an opacifying contrast agent.

Dr. Michael Manyak highlighted the role of new imaging technologies in the staging of cancer patients. Extent of disease is the most critical metric when evaluating a newly diagnosed patient, and these technologies are helping us to obtain that type of information. In prostate cancer, tracers such as <sup>111</sup>In-ProstaScint® enable physicians to search for extraprostatic and metastatic disease that cannot be visualized through other means. New positron emission tomography (PET) tracers hold promise also, but current PET imagers are not optimized for this anatomy. In bladder cancer, optical coherence tomography (OCT) can reliably distinguish invasive carcinoma from localized tumors, a distinction that has a critical impact on patient treatment.

### **III. KEY RESEARCH ACCOMPLISHMENTS**

Although this project is not a typical scientific research endeavor, we can point to several key results that have benefited the scientific and engineering community:

- These workshops were the first of their kind and represent a significant step forward in bringing together academic biomedical engineering resources in the Washington area. Each workshop had between 50 and 75 attendees.
- The WABME website is becoming a central location for obtaining information about biomedical engineering in the area. As it evolves, it will come to include information from academic, industry, and government organizations.
- We have created a teaching archive of the workshop content (including audio, video, and text reports), which is available on DVD or CD media. Some of these archives are also available over the web and can therefore reach a much larger geographic region.
- The WABME framework has brought faculty in the area together and facilitated work on several cooperative research grant submissions, a trend that will certainly continue in the future.

### **IV. REPORTABLE OUTCOMES**

Reportable outcomes from this workshop series include:

- Summary workshop reports as reproduced in section II of this document
- DVDs/CDs of content from the workshops.

### **V. CONCLUSIONS**

MRMC support has enabled WABME to produce several high-quality workshops that are of tremendous benefit to the biomedical engineering community in the Washington area. These workshops serve students and faculty from local universities as well as researchers from corporations and government entities. WABME is evolving into a hub for biomedical engineering activity in the national capital region.

MRMC's support for technical equipment/training and personnel makes possible a compelling, permanent teaching archive from the workshop content in the form of video, audio, and written archives. Furthermore, WABME's framework facilitated applications for several multi-institutional research and education grants, which should significantly enhance biomedical engineering training in the Washington, DC area.

### **VI. REFERENCES**

n/a

### **VII. APPENDICES**

DVD video of workshop speakers and summary reports from workshops are available by sending an email to [register@wabme.org](mailto:register@wabme.org). Copies of the DVD have been made available to the MRMC as a non-print appendix to this report.